

**DESIGN AND DEVELOPMENT OF DRIED CHILI SEEDS  
SEPARATOR MACHINE USING DFMA METHODOLOGY**



**This Final Project Has Been Arranged as a Requirement to Complete  
Bachelor Degree Program in Mechanical Engineering Department at  
Engineering Faculty**

**Submitted by:**

**MUHAMMAD ZIYAN RIZQIN**

**D200133002**

**INTERNATIONAL PROGRAM  
MECHANICAL ENGINEERING DEPARTMENT  
ENGINEERING FACULTY  
UNIVERSITAS MUHAMMADIYAH SURAKARTA**

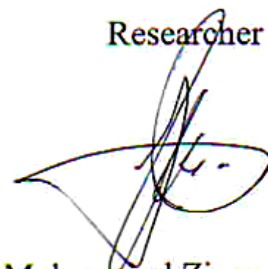
**2018**

## **DECLARATION OF RESEARCH AUTHENTICITY**

I hereby, declare this final project entitles “DESIGN AND DEVELOPMENT OF DRIED CHILI SEEDS SEPARATOR MACHINE USING DFMA METHODOLOGY” is the results of my own research which has been arranged as a requirement to complete the degree of Bachelor of Engineering program in mechanical engineering department at engineering faculty of Universitas Muhammadiyah Surakarta,except as cited in the reference that used to solve the problem.

Surakarta, 8 December 2018

Researcher

A handwritten signature in blue ink, appearing to read 'Muhammad Ziyan Rizqin', is written over a circular stamp. The signature is stylized and overlaps the stamp.

Muhammad Ziyan Rizqin

D200133002

## APPROVAL

The final project entitles “DESIGN AND DEVELOPMENT OF DRIED CHILI SEEDS SEPARATOR MACHINE USING DFMA METHODOLOGY" has been approved by supervisor as partial fulfillment of the requirement to complete the degree of Bachelor of Engineering program in mechanical engineering department at engineering faculty of UniversitasMuhammadiyah Surakarta.

Name : Muhammad Ziyan Rizqin

NIM : D200133002

Has been approved and legalized on

Day : Saturday

Date : 8 December 2018

Approved to be examined by

Supervisor



AgusDwiAnggono, ST, M.Eng, Ph.D

## VALIDATION

The final project entitles “DESIGN AND DEVELOPMENT OF DRIED CHILI SEEDS SEPARATOR MACHINE USING DFMA METHODOLOGY” has been defended in front of examiners team and approved as partial fulfillment of the requirement to complete the degree of Bachelor of Engineering program in mechanical engineering department at engineering faculty of Universitas Muhammadiyah Surakarta.

Name : Muhammad Ziyan Rizqin

NIM : D200133002

Has been approved and legalized on

Day : Saturday

Date : 8 December 2018

Team of Examiners

Head of Examiner :

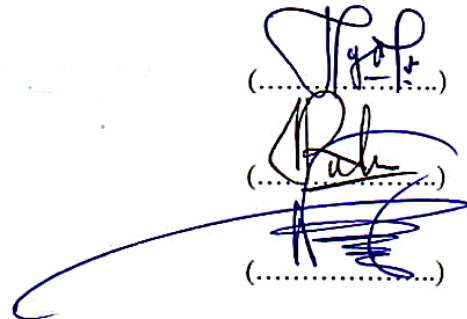
Agus Dwi Anggono, S.T, M.Eng, Ph.D

Member of Examiner I :

Dr. Muhammad Syukron

Member of Examiner II :

Wijianto, S.T, M.Eng.Sc



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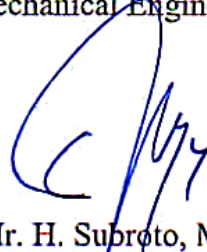
Engineering Faculty



Ir. Sri Sunarjono, M.T., Ph.D., IPM

Head of

Mechanical Engineering



Ir. H. Subroto, M.T

## **DEDICATION**

Alhamdulillahilahi rabbil'alamin, this final project expresses the highest gratitude to Allah SWT and Prophet Muhammad SAW, for blessing, guidance, love, opportunity, health and mercy to complete the degree of bachelor of engineering in mechanical engineering department at engineering faculty of Universitas Muhammadiyah Surakarta. This final project is dedicated to:

1. dr. Agus Pramono and Lilis Fatmawati as my beloved parents, Anisa Shabrina S.E, Afina Naufal S.Farm, Medina Nur Jehan as my beloved sisters that always help and support me in hard times and thanks for love, guidance, affection, prayer, and everything that has been given to me.

## **MOTTO**

Innovation distinguishes between a leader and a follower (Steve Jobs)

Innovation is the only way to win (Steve Jobs)

Innovation is taking two things that already exist and putting them together in a new way (Tom Freston)

There is no innovation and creativity without failure (Brene Brown)

Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world (Albert Einstein)

Failure is an option here. If things are not failing, you are not innovating enough (Elon Musk)

There is always room to improve (Muhammad Ziyen Rizqin)

Failure is not the end but it is the first steps to improve (Muhammad Ziyen Rizqin)

Everyone have their own timeline. Just believe what you do and focus. (Muhammad Ziyen Rizqin)

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Assalamu'alaikum. Wr. Wb

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The author realizes that this final project is still not perfect. Therefore, constructive criticism and suggestions are welcome.

Wassalamu'alaikum. Wr. Wb.

Surakarta, 8 December 2018

Muhammad Ziyen Rizqin

## ABSTRAK

Merancang suatu produk yang memiliki sedikit komponen, mudah dirakit, dan biaya produksi rendah sangat penting untuk tim perancang agar berhasil dalam pasar daya saing global. Oleh karena itu, metodologi DFMA dianggap dan banyak digunakan untuk mengatasi masalah tersebut. DFMA adalah metode yang didasarkan pada DFA dan DFM untuk memastikan produk dirancang untuk mudah diproduksi dan dirakit dengan minimum waktu dan biaya perakitan, dan biaya produksi.

Tujuan dari tugas akhir ini adalah untuk menentukan jumlah total komponen,  $TN_i$ , total waktu perakitan,  $TT_{ma}$ , dan biaya,  $TC_{ma}$ , kualitas perakitan,  $D_a$ , efisiensi desain, biaya total bahan,  $TM_c$ , total biaya pemrosesan dasar,  $TP_c$ , total koefisien biaya relatif,  $TR_c$ , total biaya manufaktur,  $TM_i$ . Produk desain yang telah ada dan yang diusulkan akan dianalisis dengan menggunakan metodologi DFMA. Perangkat lunak Solidworks digunakan untuk merancang setiap komponen dari produk yang ada dan untuk mengembangkan produk baru. Motor listrik dan analisis simulasi produk digunakan untuk memverifikasi apakah produk aman dan dapat dioperasikan dengan baik.

Berdasarkan hasil penelitian ini dapat disimpulkan bahwa desain produk mesin pemisah biji cabai kering yang ada sudah diperbaiki sehingga terjadi pengurangan sebesar 93,62% pada jumlah total komponen,  $TN_i$ . Total waktu perakitan,  $TT_{ma}$ , berkurang 95,93%. Total biaya perakitan,  $TC_{ma}$ , berkurang 95,88%. Efisiensi desain ditingkatkan dari 80,85% menjadi 22,22%, pengurangan 93,62%. Kualitas perakitan,  $D_a$ , ditingkatkan, dari 14,62% menjadi 0,45%. Total biaya material,  $TM_c$ , berkurang, dari 8881.33 menjadi 630.53 pence, pengurangan 92.90%. Total biaya pemrosesan dasar,  $TP_c$ , berkurang, dari 406,40 menjadi 121,40 pence, pengurangan 70,13%. Koefisien total biaya relatif,  $TR_c$ , berkurang dari 291,89 menjadi 134,56 pence, penurunan 53,90%. Total biaya produksi,  $TM_i$ , berkurang 85,06%, dari



12189,63 menjadi 2478,07 pence. Torsi,  $T$ , motor terpasang adalah 0,64 Nm yang lebih tinggi dari torsi,  $T$ , motor yang dibutuhkan adalah 0,58 Nm. , tekanan minimum adalah  $1,367e + 003 \text{ N/m}^2$  dan tegangan maksimum adalah  $2,562e + 006 \text{ N/m}^2$ . Ketegangan minimum adalah  $5.609e-007$  dan regangan maksimum adalah  $1.051e-003$ . Faktor keamanan minimum adalah  $1,859e + 001$  dan faktor keamanan maksimum adalah  $3,483e + 004$ . Oleh karena itu, secara teoritis desain baru mesin pemisah biji cabai kering ini aman dan dapat dioperasikan dengan baik.

**Kata kunci: Produk Desain, Mesin Pemisah Biji Cabai Kering, DFMA, DFA, DFM.**

## ABSTRACT

Designing the product that has few parts, easy to assemble, and low manufacturing cost is essential to design team in order to be successfully in global competitiveness market. Therefore, DFMA methodology is considered and widely used to overcome those problems. DFMA is a method based on DFA and DFM to ensure the product is designed to easily and efficiently manufactured and assembled with a minimum assembly time and cost, and manufacturing cost.

The purposes of this final project are to determine the total number of parts,  $TN_i$ , total assembly time,  $TT_{ma}$ , and cost,  $TC_{ma}$ , assembly quality,  $D_a$ , design efficiency, total material cost,  $TM_c$ , total basic processing cost,  $TP_c$ , total relative cost coefficient,  $TR_c$ , total manufacturing cost,  $TM_i$ . The existing and the proposed design product are analyzed by using DFMA methodology. Solidworks software is used to design of each component of the existing product and to develop the new products. Electric motor and product simulation analysis is used to verify whether the product is save and can be well operated.

Based on this research results can be concluded that the existing product design of dried chili seeds separator machine was improved resulting a reduction of 93.62% in total number of parts,  $TN_i$ . The total assembly time,  $TT_{ma}$ , was reduced by 95.93%. The total assembly cost,  $TC_{ma}$ , was reduced by 95.88%. The design efficiency was improved from 80.85% to 22.22%, a reduction of 93.62%. The assembly quality,  $D_a$ , was improved, from 14.62% to 0.45%. The total material cost,  $TM_c$ , was reduced, from 8881.33 to 630.53 pence, a reduction of 92.90%. The total basic processing cost,  $TP_c$ , was reduced, from 406.40 to 121.40 pence, a reduction of 70.13%. The total relative cost coefficient,  $TR_c$ , was reduced from 291.89 to 134.56 pence, a reduction of 53.90%. The total manufacturing cost,  $TM_i$ , was reduced by 85.06%, from 12189.63 to 2478.07 pence. The torque,  $T$ , of installed motor is 0.64 Nm which is higher than the torque,  $T$ , of required motor is 0.58 Nm. , the minimum stress is  $1.367e+003 \text{ N/m}^2$  and the maximum stress is

2.562e+006 N/m<sup>2</sup>. The minimum strain is 5.609e-007 and the maximum strain is 1.051e-003. The minimum factor of safety is 1.859e+001 and the maximum factor of safety is 3.483e+004. Therefore, theoretically the new design of dried chili seeds separator machine is save and can be well operated.

**Keywords: Design Product, Dried Chili Seeds Separator Machine, DFMA, DFA, DFM.**

## CONTENTS

<b>TITLE PAGE .....</b>	<b>i</b>
<b>DECLARATION OF RESEARCH AUTHENTICITY .....</b>	<b>ii</b>
<b>APPROVAL PAGE .....</b>	<b>iii</b>
<b>VALIDATION PAGE.....</b>	<b>iv</b>
<b>DEDICATION.....</b>	<b>v</b>
<b>MOTTO .....</b>	<b>vi</b>
<b>ACKNOWLEDGEMENTS.....</b>	<b>vii</b>
<b>ABSTRAK .....</b>	<b>viii</b>
<b>ABSTRACT .....</b>	<b>x</b>
<b>CONTENTS.....</b>	<b>xii</b>
<b>LIST OF FIGURE .....</b>	<b>xxii</b>
<b>LIST OF TABLE .....</b>	<b>xxv</b>
<b>LIST OF EQUATION .....</b>	<b>xxvii</b>
<b>LIST OF SYMBOL.....</b>	<b>xxviii</b>
<b>LIST OF ABBREVIATION.....</b>	<b>xxxi</b>
<b>LIST OF APPENDIX .....</b>	<b>xxxiii</b>

## **CHAPTER 1 INTRODUCTION**

1.1 Introduction .....	1
1.2 Problem Statement .....	2
1.3 Objectives.....	3
1.4 Scopes .....	3
1.5 Problem Significant.....	3
1.6 Expected Result.....	4

## **CHAPTER 2 LITERATURE REVIEW**

2.1 Introduction .....	5
2.2 Design for Manufacturing and Assembly (DFMA) .....	5
2.2.1 General Guidelines of DFMA .....	7
2.3 Design for Assembly (DFA) .....	8
2.3.1 General Guidelines of DFA .....	10
2.3.2 Manual Assembly.....	11
2.3.3 General Design Guidelines for Manual Assembly.....	12
2.3.4 Design Guidelines for Part Handling .....	12
2.3.5 Design Guidelines for Insertion and Fastening .....	13
2.3.6 Assembly Structure .....	16
2.3.7 Classification System .....	17
2.3.8 Part Symmetry on Handling Time .....	18
2.3.9 Part Thickness and Size on Handling Time .....	19

2.3.10 Operation Time ( $T_{ma}$ ) .....	20
2.3.11 Total Assembly Time ( $TT_{ma}$ ) .....	21
2.3.12 Operation Cost ( $C_{ma}$ ) .....	21
2.3.13 Total Assembly Cost ( $TC_{ma}$ ) .....	21
2.3.14 Design Efficiency .....	22
2.3.15 Assembly Quality ( $D_a$ ).....	23
2.4 Design for Manufacture (DFM) .....	23
2.4.1 General Guidelines of DFM.....	24
2.4.2 Selection Materials and Processes .....	25
2.4.3 Manufacturing Cost ( $M_i$ ).....	26
2.4.4 Total Manufacturing Cost ( $TM_i$ ).....	27
2.4.5 Material Cost ( $M_c$ ) .....	28
2.4.6 Total Material Cost ( $TM_c$ ).....	29
2.4.7Basic Processing Cost ( $P_c$ ) .....	29
2.4.8 Total Basic Processing Cost ( $TP_c$ ) .....	30
2.4.9Relative Cost Coefficient ( $R_c$ ).....	30
2.4.10Total Relative Cost Coefficient ( $TR_c$ ).....	30
2.4.11Material to Process Suitability ( $C_{mp}$ ).....	31
2.4.12Shape Complexity ( $C_c$ ).....	31
2.4.13Section Coefficient ( $C_s$ ) .....	32
2.4.14Tolerance ( $C_t$ ) and Surface Finish ( $C_f$ )Coefficients .....	33

2.5 Implementation of DFMA.....	33
---------------------------------	----

2.6 Benchmarking Product.....	34
-------------------------------	----

## **CHAPTER 3 METHODOLOGY**

3.1 Introduction.....	36
-----------------------	----

3.2 Method of Study.....	36
--------------------------	----

3.3 Selection and Product Specification .....	38
---	----

3.3.1 Selection Product .....	38
-------------------------------	----

3.3.2 Product Specification .....	38
-----------------------------------	----

3.4 Benchmarking of Product Specification from Commercial Product .....	39
---	----

3.5 The Existing Design Product Disassemblies.....	39
--	----

3.6 The Procedures of Redesign Process .....	39
--	----

3.7 Computer Aided Drawing (CAD) Modelling .....	40
--	----

3.8 The Procedures Boothroyd DFMA Manual Analysis.....	40
--	----

3.8.1 The Procedures Boothroyd DFMA Manual Analysis .....	40
---	----

3.8.2 The Procedures Boothroyd DFM Manual Analysis.....	41
---	----

3.9 Comparison Method.....	42
----------------------------	----

3.10 Electric Motor Analysis .....	42
------------------------------------	----

3.11 Product Analysis and Simulation.....	42
---	----

## **CHAPTER 4 RESULT AND DISCUSSION**

4.1 Introduction.....	43
-----------------------	----

4.2 Boothroyd DFMA Analysis .....	43
-----------------------------------	----

4.2.1 Boothroyd DFA Analysis of the Existing Design Product .....	43
4.2.1.1 CAD Modelling.....	44
4.2.1.2 Assembly Structure Diagram .....	45
4.2.1.3 Determination of Total Symmetry per Component .....	45
4.2.1.4 Determination of Part Size and Thickness per Component .....	45
4.2.1.5 Determination of Operation Time ( $T_{ma}$ ) per Component .....	45
4.2.1.6 Determination of Total Assembly Time ( $TT_{ma}$ ) .....	46
4.2.1.7 Determination of Operation Cost ( $C_{ma}$ ) per Component .....	46
4.2.1.8 Determination of Total Assembly Cost ( $TC_{ma}$ ) .....	47
4.2.1.9 Determination of Design Efficiency .....	52
4.2.1.10 Determination of Assembly Quality ( $D_a$ ) .....	52
4.2.2 Boothroyd DFM Analysis of the Existing Design Product.....	53
4.2.2.1 Selection of Materials and Processes .....	53
4.2.2.2 Determination of Component Volume ( $V$ ) .....	54
4.2.2.3 Determination of Material Cost ( $M_c$ ) .....	54
4.2.2.4 Determination of Total Material Cost ( $TM_c$ ) .....	55
4.2.2.5 Determination of Basic Processing Cost ( $P_c$ ) .....	55
4.2.2.6 Determination of Total Basic Processing Cost ( $TP_c$ ) .....	55
4.2.2.7 Determination of Component Shape Complexity ( $C_c$ ) .....	56
4.2.2.8 Determination of Section Coefficient ( $C_s$ ) .....	57



4.2.2.9 Determination of Tolerance ( $C_t$ ) and Surface Finish ( $C_f$ )	
Coefficients .....	57
4.2.2.10 Determination of Relative Cost Coefficient ( $R_c$ ) .....	57
4.2.2.11 Determination of Total Relative Cost Coefficient ( $TR_c$ ) .....	58
4.2.2.12 Determination of Manufacturing Cost ( $M_i$ ) .....	58
4.2.2.13 Determination of Total Manufacturing Cost ( $TM_i$ ) .....	61
4.2.3 Boothroyd DFA Manual Analysis of the First Design Product .....	61
4.2.3.1 CAD Modelling .....	62
4.2.3.2 Assembly Structure .....	63
4.2.3.3 Determination of Total Symmetry per Component .....	63
4.2.3.4 Determination of Part Size and Thickness per Component .....	63
4.2.3.5 Determination of Operation Time ( $T_{ma}$ ) per Component .....	66
4.2.3.6 Determination of Total Assembly Time ( $TT_{ma}$ ) .....	66
4.2.3.7 Determination of Operation Cost ( $C_{ma}$ ) per Component .....	66
4.2.3.8 Determination of Total Assembly Cost ( $TC_{ma}$ ) .....	67
4.2.3.9 Determination of Design Efficiency .....	67
4.2.3.10 Determination of Actual Improvement .....	67
4.2.3.11 Determination of Assembly Quality ( $D_a$ ) .....	68
4.2.3.12 Design Change .....	68
4.2.4 Boothroyd DFM Manual Analysis of the First Design Product .....	68
4.2.4.1 Selection of Materials and Processes .....	72

4.2.4.2 Determination of Component Volume ( $V$ ) .....	72
4.2.4.3 Determination of Material Cost ( $M_c$ ) .....	72
4.2.4.4 Determination of Total Material Cost ( $TM_c$ ) .....	73
4.2.4.5 Determination of Basic Processing Cost ( $P_c$ ) .....	74
4.2.4.6 Determination of Total Basic Processing Cost ( $TP_c$ ) .....	74
4.2.4.7 Determination of Component Shape Complexity ( $C_c$ ) .....	75
4.2.4.8 Determination of Section Coefficient ( $C_s$ ) .....	75
4.2.4.9 Determination of Tolerance ( $C_t$ ) and Surface Finish ( $C_f$ ) Coefficients .....	75
4.2.4.10 Determination of Relative Cost Coefficient ( $R_c$ ) .....	76
4.2.4.11 Determination of Total Relative Cost Coefficient ( $TR_c$ ) .....	76
4.2.4.12 Determination of Manufacturing Cost ( $M_i$ ) .....	77
4.2.4.13 Determination of Total Manufacturing Cost ( $TM_i$ ) .....	77
4.2.5 Boothroyd DFA Analysis of the Second Design Product .....	77
4.2.5.1 CAD Modelling .....	78
4.2.5.2 Assembly Structure Diagram .....	81
4.2.5.3 Determination of Total Symmetry per Component .....	81
4.2.5.4 Determination of Part Size and Thickness per Component .....	82
4.2.5.5 Determination of Operation Time ( $T_{ma}$ ) per Component .....	83
4.2.5.6 Determination of Total Assembly Time ( $TT_{ma}$ ) .....	84
4.2.5.7 Determination of Operation Cost ( $C_{ma}$ ) per Component .....	84

4.2.5.8 Determination of Total Assembly Cost ( $TC_{ma}$ ).....	84
4.2.5.9 Determination of Design Efficiency .....	85
4.2.5.10 Determination of Actual Improvement .....	85
4.2.5.11 Determination of Assembly Quality ( $D_a$ ) .....	85
4.2.5.12 Design Change .....	86
4.2.6 BoothroydDFM Analysis of the Second Design Product .....	87
4.2.6.1 Selection of Materials and Processes .....	87
4.2.6.2 Determination of Component Volume ( $V$ ) .....	88
4.2.6.3 Determination of Material Cost ( $M_c$ ) .....	88
4.2.6.4 Determination of Total Material Cost ( $TM_c$ ) .....	88
4.2.6.5 Determination of Basic Processing Cost ( $P_c$ ).....	89
4.2.6.6 Determination of Total Basic Processing Cost ( $TP_c$ ).....	89
4.2.6.7 Determination of Component Shape Complexity ( $C_c$ ).....	90
4.2.6.8 Determination of Section Coefficient ( $C_s$ ) .....	90
4.2.6.9 Determination of Tolerance ( $C_t$ ) and Surface Finish ( $C_f$ ) Coefficients .....	90
4.2.6.10 Determinationof Relative Cost Coefficient ( $R_c$ ) .....	91
4.2.6.11 Determinationof Total Relative Cost Coefficient ( $TR_c$ ) .....	91
4.2.6.12 Determinationof Manufacturing Cost ( $M_i$ ) .....	92
4.2.6.13 Determination of Total Manufacturing Cost ( $TM_i$ ) .....	93
4.3 DFMA Analysis Result of the Existing, First, and Second Design Products .....	93

4.3.1 DFA Analysis Result of the Existing, First, and Second Design Products.....	93
4.3.2 DFM Analysis Result of the Existing, First, and Second Design Products .....	96
4.4 Comparison Method of the Existing, First, and Second Design products	98
4.4.1 Comparison of Design Efficiency, Actual Improvement, and Assembly Quality( $D_a$ ).....	98
4.4.2 Comparison of Total Assembly Time( $TT_{ma}$ ) .....	99
4.4.3 Comparison of Total Assembly Cost( $TC_{ma}$ ) .....	99
4.4.4 Comparison of Total Material Cost( $TM_c$ ), Total Basic Processing Cost( $TP_c$ ), and Total RelativeCost Coefficient( $TR_c$ ) .....	100
4.4.5 Comparison of Total Manufacturing Cost ( $TM_i$ ).....	101
4.5 Electric Motor Analysis .....	101
4.6 Product Analysis and Simulation .....	103
4.6.1 Model information .....	104
4.6.2 Material Properties .....	105
4.6.3 Loads and Fixtures .....	105
4.6.4 Contact Information .....	107
4.6.5 Mesh Information.....	107
4.6.6 Product Analysis and Simulation Result.....	109
 <b>CHAPTER 5 CONCLUSION AND RECOMMENDATION</b>	
5.1 Introduction .....	113
5.2 Conclusion .....	113
5.3 Recommendation .....	114

<b>REFERENCES</b> .....	116
<b>APPENDICES</b> .....	119

## LIST OF FIGURE

1.1 The existing dried chili seeds separator machine.....	2
2.1 General steps taken in a DFMA study .....	6
2.2 Symmetrical parts are generally easier to insert and assemble .....	11
2.3 Parts that tangle .....	11
2.4 Some other features affecting part handling .....	13
2.5 Incorrect geometry can allow a part to jam during insertion .....	13
2.6 (a) Design for ease of insertion-assembly of long-stepped bushing into counterbored hole, (b) Provisions of chamfers to allow easy insertion .....	14
2.7 Provision of air-relief passages to improve insertion into blind holes.....	14
2.8 (a) Standardize parts, (b) single-axis pyramid assembly .....	15
2.9 Provision of self-locating features to avoid holding down and alignment.....	15
2.10 Design to aid insertion .....	15
2.11 (a) Common fastening methods, (b) insertion from opposite direction requires repositioning of the assembly.....	16
2.12 Example format of an assembly structure diagram.....	17
2.13 Part thickness on handling time .....	19
2.14 Part size on handling time .....	20
2.15 Material cost per unit volume ( $C_{mt}$ ) for commonly used material classes .....	28
2.16 Shape classification used in the determination ( $C_c$ ) .....	31
3.1 Method of study flow chart.....	37

3.2 The Existing Product Specification.....	38
4.1 CAD modelling of the existing design product .....	44
4.2 CAD modelling in exploded drawing of the existing design product.....	44
4.3 Cutting blade of the existing design products on Solidworks software.....	54
4.4 Basic processing cost ( $P_c$ ) cutting blade of the existing product design .....	56
4.5 Shape complexity coefficient ( $C_c$ ) cutting blade of the existing product design .....	59
4.6 Sheet metal work section coefficient ( $C_s$ ) cutting blade of the existing product design .....	60
4.7 Sheet metal work tolerance coefficient ( $C_t$ ) cutting blade of the existing product design .....	60
4.8 Sheet metal work surface finish coefficient ( $C_f$ ) cutting blade of the existing product design .....	61
4.9 CAD modelling of the first design product.....	62
4.10 CAD modelling in exploded drawing of the first design product.....	62
4.11 Cutting blade of the first design product in Solidworks software.....	73
4.12 Basic processing cost ( $P_c$ ) cutting blade of the first design product .....	74
4.13 Shape complexity coefficient ( $C_c$ ) cutting blade of the first design product.....	79
4.14 Sheet metal work section coefficient ( $C_s$ ) cutting blade of the first design product .....	80
4.15 Sheet metal work tolerance coefficient, ( $C_t$ ), cutting blade of the first design product .....	80
4.16 Sheet metal work surface finish coefficient, ( $C_f$ ), cutting blade of the first design product .....	81

4.17 CAD modelling of the second design product .....	78
4.18 CAD modelling in exploded drawing of the second design product .....	78
4.19 Cutting blade of the second design product in Solidworks software .....	89
4.20 Basic processing cost ( $P_c$ ) cutting blade of the second design product.....	92
4.21 Shape complexity coefficient ( $C_c$ ) cutting blade of the second design product.....	94
4.22 Sheet metal work section coefficient ( $C_s$ ) cutting blade of the second design product .....	95
4.23 Sheet metal work tolerance coefficient ( $C_t$ ) cutting blade of the second design product .....	95
4.24 Sheet metal work surface finish coefficient ( $C_f$ ) cutting blade of the second design product .....	96
4.25 Comparison of design efficiency, actual improvement, and assembly quality ( $D_a$ ) between the existing and proposed design.....	99
4.26 Comparison of total assembly time ( $TT_{ma}$ ) between the existing and proposed design.....	100
4.27 Comparison of total assembly cost ( $TC_{ma}$ ) between the existing and proposed design.....	101
4.28 Comparison of total material cost ( $TM_c$ ), total basic processing cost ( $TP_c$ ), and total relative cost coefficient ( $TR_c$ ), between the existing and proposed design .....	102
4.29 Comparison of total manufacturing cost, ( $M_i$ ), between the existing and proposed design.....	102



## LIST OF TABLE

2.1 The principles of DFMA including the advantages and opportunities .....	8
4.1 Total symmetry per component of the existing design product .....	47
4.2 Part size and thickness per component of the existing product design .....	50
4.3 Total symmetry per component of the first design product .....	63
4.4 Part size and thickness per component of the first design product .....	65
4.5 Design change associated time and cost savings of the first design product .....	69
4.6 Total symmetry per component of the second design product .....	82
4.7 Part size and thickness per component of the second design product .....	83
4.8 Design change associated time and cost savings of the second design product .....	86
4.9 DFA analysis result of the existing, first, and second design products .....	97
4.10 DFM analysis result of the existing, first, and second design products .....	98
4.11 Model information of the second design product .....	104
4.12 Material properties of the second design product .....	105
4.13 Fixtures of the second design product .....	105
4.14 Loads of the second design product .....	106
4.15 Contact information of the second design product .....	107
4.16 Mesh information of the second design product .....	107
4.17 Stress analysis and simulation result of the second design product .....	109
4.18 Strain analysis and simulation result of the second design product .....	110

4.19 Factor of safety analysis and simulation result of the second design product .....	111
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## LIST OF EQUATION

2.1 Total angle of symmetry .....	19
2.2 Operation Time ( $T_{ma}$ ) .....	20
2.3 Total Assembly Time ( $TT_{ma}$ ) .....	21
2.4 Operation Cost ( $C_{ma}$ ) .....	21
2.5 Total Assembly Cost ( $TC_{ma}$ ) .....	21
2.6 Design Efficiency .....	22
2.7 Actual Improvement .....	22
2.8 Assembly Quality ( $D_a$ ) .....	23
2.9 Manufacturing Cost ( $M_i$ ) .....	27
2.10 Total Manufacturing Cost ( $TM_i$ ) .....	27
2.11 Material Cost ( $M_c$ ) .....	28
2.12 The formulation of finished volume ( $V_f$ ) .....	29
2.13 Total Material Cost ( $TM_c$ ) .....	29
2.14 Basic Processing Cost ( $P_c$ ) .....	29
2.15 Total Basic Processing Cost ( $TP_c$ ) .....	30
2.16 Relative Cost Coefficient ( $R_c$ ) .....	30
2.17 Total Relative Cost Coefficient ( $TR_c$ ) .....	30

## LIST OF SYMBOL

$N_i$	- Number of items
$TN_i$	- Total number of parts
$H_t$	- Estimated handling times
$l_t$	- Estimated insertion times
$T_{ma}$	- Operation time per component
$TT_{ma}$	- Total assembly time
$C_{ma}$	- Operation cost per component
$TC_{ma}$	- Total assembly cost
$D_a$	- Assembly quality or probability a defective assembly
$V$	- Volume
$V_f$	- Finished volume
$M_c$	- Material cost
$T_{mc}$	- Total material cost
$P_c$	- Basic processing cost
$TP_c$	- Total basic processing cost
$R_c$	- Relative cost coefficient
$TR_c$	- Total relative cost coefficient
$C_l$	- Labour rate
$M_i$	- Manufacturing cost
$TM_i$	- Total manufacturing cost
$\alpha$	- Alpha rotational symmetry
$\beta$	- Beta rotational symmetry
mm	- Milimeter
s	- Second
%	- Percentage

$N_{min}$	- Theoretical minimum number of components
$N_{int}$	- Number of components in initial design
$N_{red}$	- Number of components in redesign
$t_i$	- Average assembly time per operation
$n$	- Assembly operations
$C_{mt}$	- Cost of the material per unit volume in the required form
$\text{mm}^3$	- Cubic millimeter
$\mu\text{m}$	- Micrometer
$W_c$	- Waste coefficient
$N$	- Total production quantity per annum
$T$	- Time for processing an ideal design of component
$\alpha$	- Cost of setting up and operating a specific process
$\beta$	- A specific process total tooling for an ideal design
$C_{mp}$	- Material process suitability
$C_c$	- Component shape complexity
$C_s$	- Component section coefficient
$C_{ft}$	- Higher of $C_t$ and $C_f$
$C_t$	- Component tolerance coefficient
$C_f$	- Component surface finish coefficient
$\text{Kg}$	- Kilogram
$\text{N}$	- Newton
$\text{m}^3$	- Cubic meter
$\text{m}^2$	- Square meter
$\text{N/m}^2$	- Pascal
$\text{Kg/m}^3$	- Mass density
$\text{HP}$	- Horse power
$\text{Nm}$	- Joule

$M_{mc}$	- Mass of chili
$M_{cb}$	- Mass of cutting blade
$M_{ro}$	- Mass of shaft rotator
$M_{fb}$	- Mass of fan blade
$g$	- Gravity of earth
$m/s^2$	- Acceleration
$F_{ult}$	- Ultimate force
$F_{apl}$	- Applied force
$P$	- Power
$T$	- Torque
Pence	- A plural of penny, a coin or unit of currency
Cent	- A monetary unit that equals 1/100 of the basic monetary unit

## **LIST OF ABBREVIATION**

DCSMM	- Dried Chili Seeds Separator Machine
DFMA	- Design for Manufacturing and Assembly
DFA	- Design for Assembly
DFM	- Design for manufacture
FOS	- Factor of Safety
PLC	- Product life cycle
CAD	- Computer aided design
AM	- Auto machining
CCEM	- Cold continuous extrusion (metals)
CDF	- Closed die forging
CEP	- Continuous extrusion (plastic)
CF	- Cold forming
CH	- Cold heading
CM2.5	- Chemical milling (2.5 mm depth)
CM5	- Chemical milling (5 mm depth)
CMC	- Ceramic mould casting
CNC	- Computer numerical controlled machining
CPM	- Compression moulding
GDC	- Gravity die casting
HCEM	- Hot continuous extrusion (metals)
IC	- Investment casting
IM	- Injection moulding
MM	- Manual machining
PDC	- Pressure die casting
PM	- Powder metallurgy

SM	- Shell moulding
SC	- Sand casting
SMW	- Sheet metal work
VF	- Vacuum forming
RS	- Rupee India or Sri lanka
RM	- Ringgit Malaysia
VON	- Von mises stress
ESTRN	- Equivalent strain



## LIST OF APPENDIX

- A1 Original classification system for part features affecting manual handling time (s)
- A2 Original classification system for part features affecting manual insertion time (s)
- A3 *Alpha* and *Beta* rotational symmetries for various part
- B1 Compatibility between materials and processes
- B2 Capabilities of a range of manufacturing processes
- B3 Manufacturing processes and materials PRIMA selection matrix
- B4 Basic processing cost ( $P_c$ ) against annual product quantity
- B5 Waste coefficient ( $W_c$ ) for the sample processes relative to shape classification category
- B6 Relative cost data for material processing suitability ( $C_{mp}$ )
- B7 Shape classification categories used in the determination ( $C_c$ )
- B8 Determination of shape complexity coefficient ( $C_c$ )
- B9 Chart used for the determination of the section coefficient ( $C_s$ )
- B10 Chart used for the determination of the tolerance coefficient ( $C_t$ )
- B11 Chart used for the determination of the surface finish coefficient ( $C_f$ )
- C1 Benchmarking product specifications from commercial products
- D1 Design for manual assembly – worksheet of the existing design product
- D2 Design for manual assembly – worksheet of the first design product
- D3 Design for manual assembly – worksheet of the second design product
- E1 Design for manual manufacture – worksheet of the existing design product
- E2 Design for manual manufacture – worksheet of the first design product
- E3 Design for manual manufacture – worksheet of the second design product
- F1 Assembly structure diagram of the existing design product
- F2 Assembly structure diagram of the first design product
- F3 Assembly structure diagram of the second design product
- G1 Existing design product drawing, exploded drawing, and BOM
- G2 First design product drawing, exploded drawing, and BOM

G3 Second design product drawing, exploded drawing, and BOM